

Biomass Burning Losses of Carbon Estimated from Ecosystem Modeling and Satellite Data Analysis for the Brazilian Amazon Region

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To produce a new daily emissions record of carbon from biomass burning events in the states of the Brazilian Legal Amazon, the staff has used vegetation greenness estimates from satellite images as inputs to a terrestrial ecosystem production model. This carbon allocation model generates new estimates of regional vegetation biomass at eight kilometer resolution. The modeled biomass product is then combined for the first time with fire pixel counts from the Advanced Very High Resolution Radiometer (AVHRR) to overlay regional burning activities in the Amazon.

Results from this analysis indicate that carbon emission estimates from annual region-wide sources of deforestation and biomass burning in the early 1990s are apparently three to five times higher than reported in previous studies for the Brazilian Legal Amazon, i.e., studies which implied that the Legal Amazon region tends toward a net-zero annual source of

terrestrial carbon. In contrast, this analysis implies that the total net source fluxes from the Legal Amazon region range from 0.2 to 1.2 petagrams (Pg) of carbon annually, depending strongly on annual rainfall patterns. The reasons for the higher burning emission estimates are (1) use of combustion fractions typically measured during Amazon forest burning events for computing carbon losses, (2) more detailed geographic distribution of vegetation biomass and daily fire activity for the region, and (3) inclusion of fire effects in extensive areas of the Legal Amazon covered by open woodland, secondary forests, savanna, and pasture vegetation. The total area of rainforest estimated annually to be deforested did not differ substantially among the previous analyses and this one.

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New Technology Developed and Tested for Disaster Management and Mitigation

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Disasters are costly both in human life and loss of homes. Yearly, these disasters result in 133,000 deaths and 140 million homeless worldwide. Current technology for monitoring fires has relied on instrument designs that are 15 to 20 years old; these systems are large, heavy, and usually have not been designed for fire characterization and mapping.

Through a government and industry partnership, new technology has been built and tested specifically for fire monitoring. "FireMapper," a multispectral microbolometer has been built by Space Instruments, Inc. through a Small Business Innovative Research (SBIR) program sponsored by the United States Forest Service (USFS) Pacific Southwest Riverside Fire Lab.

This new technology offers a small highly calibrated instrument for use in aircraft and uninhabited airborne vehicles.

The NASA-USFS Environmental Initiative and NASA's Office of Earth Science Natural Hazards Program sponsored the development of an instrument package to meet the needs of the disaster community. Requirements and specifications summarized by many user workshops and conferences resulted in the microbolometer being integrated with two visible/near infrared digital cameras to provide vegetation (fuel) and fire data.

The Brazil deployment provided a unique opportunity to test and evaluate this new technology. To characterize the variability found in savanna and tropical forest fires, and to map forest clearing, this system was flown over prescribed fires and forests of central

Brazil. For the first time, this system provided calibrated multispectral data of fire activity resulting in fire temperature and intensity information. The data from FireMapper will allow scientists to compare fire behavior over differing ecosystems and vegetation types. This information will provide a better understanding of the importance of fire in greenhouse gas generation and ecosystem succession. Other collaborators in this research were P. Riggan and R. Lockwood, USFS; J. Hoffman, Space Instruments, Inc.; J. A. Pereira, IBAMA, Brazil; E. Stoner, U.S. Aid for International Development; H. Miranda and A. Miranda, University of Brasilia, Brazil; T. Krug, Brazilian Space Institute, Brazil.

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VINTAGE: Viticultural Integration of NASA Technologies for Assessment of the Grapevine Environment

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The quality of wine grapes is influenced by such factors as ratio of fruit weight to vine leaf area, amount of sunlight directly intercepted by grape clusters, and water stress levels. Vineyard canopy density (leaf area index (LAI)) is thus a key variable of interest. California premium winegrowers are making increasing use of optical remote sensing as an additional tool for monitoring canopy density and managing vineyards. In particular, prior NASA research has demonstrated the use of high spatial resolution (two meters) vegetation index imagery for subdividing individual fields ("blocks") for harvest based upon end-of-season vigor, as inferred by canopy density. Block segmentation can result in more uniformly mature wine "lots" and, ultimately, in some cases, in improved wine quality. The

VINTAGE project is a public-private partnership dedicated to the further development of geospatial technologies and process modeling as vineyard management tools. Project investigators continue to examine relationships among vine stress, canopy development, and resulting wine quality by combining remote sensing with an agro-ecosystem process model.

Ground-based measurements of LAI were made on 50 vineyard plots (~405 hectares) located on two different Napa Valley ranches owned and operated by the Robert Mondavi Winery. The LAI2000 Plant Canopy Analyzer (LI-COR, Inc., Lincoln, Nebraska) was calibrated with destructive harvest of 12 grapevines (i.e., measurement of fruit, leaf and stem weights, leaf area). Global positioning system (GPS) measurements were made of all 50 plots